

CLAIMS

1. A crystal of (3R)-1-butyl-2,5-dioxo-3-[(1R)-1-hydroxy-1-cyclohexylmethyl]-9-[4-(4-carboxyphenoxy)phenylmethyl]-1,4,9-triazaspiro[5.5]undecane hydrochloride.
2. The crystal according to claim 1, which is a non-solvate.
3. The crystal according to claim 1, which has a melting point of about 230°C to about 240°C.
4. The crystal according to claim 1, which has a melting point of about 232°C to about 235°C.
5. The crystal according to claim 1, which has a powdery X ray diffraction spectrum shown in Fig. 1.
6. The crystal according to claim 5, which has diffraction angle 2θ of 5.15, 8.06, 10.26, 11.01, 13.72, 15.46, 17.36, 18.03, 18.58, 19.00, 19.51, 20.71, 21.73, 22.58, 23.80, 24.96 and 27.07(degree) on the powdery X ray diffraction spectrum.
7. The crystal according to claim 1, which has an IR absorption spectrum shown in Fig. 3.
8. The crystal according to claim 7, which has absorptions at 2924, 2504, 1682, 1632, 1597, 1503, 1426, 1377, 1235, 1163, 1098, 961, 928, 876, 855, 770, 727 and 681 cm^{-1} on the IR absorption spectrum.

9. The crystal according to claim 1, which has a mean particle size of about 0.05 μm to about 200 μm .

10. The crystal according to claim 2, which is a crystal of $P2_1$ space group.

11. The crystal according to claim 10, which has lattice constants of $a = 11.8105 \text{ \AA} \pm 7\%$, $b = 7.8730 \text{ \AA} \pm 7\%$ and $c = 18.2351 \text{ \AA} \pm 7\%$.

12. The crystal according to claim 2, which is substantially free of a lower alcohol solvent or a water-miscible ether solvent or contains it in a residual amount of 5,000 ppm or less.

13. A process for producing a crystal of a non-solvate of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenoxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride, which comprises carrying out crystallization from a lower alcohol solvent which may contain water or a water-miscible ether solvent which may contain water, in which a crudely purified substance of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenoxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride is dissolved or suspended.

14. The process according to claim 13, wherein the lower alcohol solvent is C_{1-4} alkyl alcohol or C_{1-4} alkyl acetate.

15. The process according to claim 14, wherein the lower alcohol solvent is methanol or ethanol.

16. The process according to claim 14, wherein the lower alcohol solvent is ethyl acetate.

17. The process according to claim 13, wherein the water-miscible ether solvent is 1,2-dimethoxyethane, dioxane or tetrahydrofuran.

18. The process according to claim 13, wherein the water and the lower alcohol solvent or the water and the water-miscible ether solvent are mixed in a mixing volume ratio of 1 : 50 to 7 : 3.

19. The process according to claim 18, wherein the water and the lower alcohol solvent or the water and the water-miscible ether solvent are mixed in a mixing volume ratio of 1 : 35 to 5 : 5.

20. The process according to claim 13, wherein the crystallization is carried out at about -10°C to about 40°C.

21. The process according to claim 13, wherein the crystallization is carried out for about 20 minutes to about 5 hours.

22. A crystal of a non-solvate of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxy-phenyloxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride which is obtainable by the process according to any one of claims 13 to 21.

23. A process for producing a crystal of a non-solvate of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenoxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride, which comprises: dissolving or suspending (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenoxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane and hydrogen chloride in a solvent selected from (1) C₁₋₄ alkyl alcohol, (2) a mixed solvent of C₁₋₄ alcohol and water, (3) a water-miscible ether solvent, (4) a mixed solvent of a water-miscible ether solvent and water, (5) a mixed solvent of C₁₋₄ alkyl alcohol and a water-miscible ether solvent, (6) a mixed solvent of C₁₋₄ alkyl alcohol, a water-miscible ether solvent and water and (7) water, followed by heating at about 40°C to about 80°C; and cooling the resulting mixture at about -5°C to about 35°C.

24. The process according to claim 23, wherein the C₁₋₄ alcohol is methanol or ethanol.

25. The process according to claim 23, wherein the water-miscible ether solvent is 1,2-dimethoxyethane, dioxane or tetrahydrofuran.

26. The process according to claim 23, which comprises: dissolving or suspending (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenoxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane and hydrogen chloride in a solvent selected from (1) C₁₋₄ alkyl alcohol, (2) a mixed solvent of C₁₋₄ alcohol and water, (3) a water-miscible ether solvent, (4) a mixed solvent of a water-miscible ether solvent and water, (5) a mixed solvent of C₁₋₄ alkyl alcohol and a water-miscible ether solvent, (6) a mixed solvent of C₁₋₄ alkyl alcohol, a water-miscible ether solvent and water and (7) water, followed by heating at about 40°C to about 80°C; cooling the

resulting mixture at about -5°C to about 35°C; adding C₁₋₄ alcohol or a water-miscible ether solvent to the mixture; and optionally adding water to the mixture.

27. A process for producing a crystal of a non-solvate of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenyloxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride, which comprises dissolving or suspending a solvate of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenyloxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride or amorphous (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenyloxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride in C₁₋₄ alkyl acetate, followed by heating at about 40°C to about 80°C; and cooling the resulting mixture at about -5°C to about 35°C.

28. A crystal of a non-solvate of (3R)-1-butyl-2,5-dioxo-3-((1R)-1-hydroxy-1-cyclohexylmethyl)-9-(4-(4-carboxyphenyloxy)phenylmethyl)-1,4,9-triazaspiro[5.5]undecane hydrochloride which is obtainable by the process according to any one of claims 20 to 24.

29. The crystal according to claim 28, which has a mean particle size of about 0.05 µm to about 200 µm.

30. A pharmaceutical composition comprising the crystal according to any one of claims 1, 22 and 28 as an active ingredient.

31. The pharmaceutical composition according to claim 30, which is a regulator of interaction between chemokine and a chemokine receptor.

32. The pharmaceutical composition according to claim 31, which is an agent for treating and/or preventing diseases caused by interaction between chemokine and a chemokine receptor.

33. A method for treating and/or preventing diseases caused by interaction between chemokine and a chemokine receptor in a mammal, which comprises administering to a mammal an effective amount of the crystal according to any one of claims 1, 22 and 28.

34. Use of the crystal according to any one of claims 1, 22 and 28 in the manufacture of an agent for treating and/or preventing diseases caused by interaction between chemokine and a chemokine receptor.